REMARKS

Favorable reconsideration of the above-referenced application is respectfully requested.

A. SUMMARY OF THIS AMENDMENT

In this Amendment, claim 1 is slightly amended to highlight a feature already recited therein. New claims 11 - 14 are added. No claims are cancelled. Thus claims 1-14 now remain pending. All prior art rejections are respectfully traversed.

B. THE NEW CLAIMS

New claims 11 - 14 have been added. New claims 11 - 13 are self-explanatory with reference to the original and amended claims. Remarks in Section C hereof apply to the new claims 11 - 13.

New independent claim 14 concerns an aspect of the invention wherein the current diffusion layer is lattice-mismatched with the light-emitting structure and the semiconductor substrate, with the semiconductor substrate being inclined in a [011] direction with respect to a (100) plane thereof. Support for newe independent claim 14 resides, e.g., in the second full paragraph of page 22 of the specification. The art of record does not appear specifically to address the subject matter of new independent claim 14.

C. THE PATENTABILITY OF THE CLAIMS

Claims 1, 3-10 stand rejected under 35 U.S.C. §102(b) as being anticipated by European Patent 0 434 233 to Fletcher (hereinafter "Fletcher '233"). Claim 2 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Fletcher '233 in view of U.S. Patent No. 5,153,889 to Sugawara ("Sugawara"). All prior art rejections are respectfully traversed for at least the following reasons.

Claim Rejections- 35 U.S.C. §102

The present invention (as described, e.g., in independent claims 1 and 11) concerns a light-emitting diode comprising *inter-alia* a semiconductor substrate and a layered structure, with the layered structure having a *current diffusion layer comprising an AlGaInP type material*. The current diffusion layer being lattice-mismatched with the light-emitting structure. The lattice mismatch $\Delta a/a$ of the current diffusion layer with respect to the light-emitting structure as defined by the expression $\Delta a/a = (a_d - a_e)/a_e$ is -1% or smaller.

As illustrated by way of example in Figure 4 and recited at portions of the present specification corresponding to Figure 4 at col. 24, lines 20 to page 25, lines 15, the light-emitting diode 100 includes an n-type GaAs substrate 1, a layered structure 12. The layered structure 12 includes an n-type GaAs buffer layer 2, an $(Al_xGa_{1-x})_{0.51}In_{0.49}P$ light-emitting structure 11, and a p-type $(Al_xGa_{1-x})_yIn_{1-y}P$ current diffusion layer 10.

In contrast to the claimed invention, Fletcher '233 discloses a light-emitting diode with an electrically conducting window layer wherein "...an electrically conductive window layer 24 grown over p-type AlGaInP confining layer 23. The window layer 24 is a III-V semiconductor alloy different from AlGaInP...." See col. 3, lines 35-40, col. 5, lines 45-55.

It is well-established that in order to properly reject claims based on anticipation, the Examiner is required to make a prima-facie showing that a single reference teach (i.e., identically describe) each and every element or the step of a rejected claim. Since Fletcher '233 discloses that the window layer is made of GaP, it teaches away from the claimed invention which requires that the current diffusion layer/window layer be made of AlGaInP. In fact, the construction of the light-emitting diode of Fletcher '233 is made by taking into account that the window layer be made of a III-V material different from AlGaInP. See, for example, the process steps as disclosed at col. 5, lines 33 through col.

6, lines 25. More importantly, portions of Fletcher '233 starting at col. 6, line 8 disclose that the "...GaP layer is grown at a much higher growth rate than the AlGaInP since dislocations in this layer are of little significant..." Therefore, substituting the window layer 24 made of GaP with a AlGaInP layer would be against the teachings of Fletcher '233 as acknowledged at col. 3, lines 37-38 by Fletcher '233.

Further claims 1 and 12 particularly concern an extent of lattice mismatch (also described at page 27, lines 17-20 of the present specification). The lattice mismatch with respect to the underlying light-emitting structure 11 and the substrate 1 is preferably of about –1% or less...". The claimed invention not only requires that the lattice mismatch between the current diffusing layer and the light-emitting structure be –1% of less, but also recites an equation for calculating the lattice-mismatch of the current diffusion layer with respect to the light emitting structure. Fletcher '233 merely identifies that a lattice mismatch between the GaP window layer and the active layer. Fletcher fails to teach or suggest the extent or nature of the lattice mismatch, and certainly falls short of the particular expression utilized in Applicants' claims 1 and 12.

In view of the above, Applicants respectfully traverse allegations of anticipation of the claimed subject matter by the independent claims 1 and 11. Moreover, for reasons including the foregoing, Applicants further submit that claims 3-10 are not anticipated, and have yet further distinguishing features, and accordingly are also allowable.

For example, dependent claim 4 defines a preferably specific composition of the AlGaInP type current diffusion layer, in that a composition of the current diffusion layer is expressed as $(Al_xGa_{1-x})_yIn_{1-y}P$, wherein x is set in the range of 0.01 to 0.05 and 1-y is set in the range of 0.01 to 0.30 in the composition.

Claim Rejections –35 U.S.C. §103

Claim 2 depends from independent claim 1 and adds further limitations to the requirements of claim 1. As noted above, Fletcher '233 fails to teach or suggest all the requirements of claim 1. Sugawara fails to teach or suggest the deficiencies of Fletcher '233. Since Fletcher '233 teaches away from the claimed invention, supplying the details of substrate inclination from Sugawara to the teachings of Fletcher '233 still fails to meet the requirements of the claimed invention.

In view of reasons including those set forth above, Applicants respectfully submit that claim 2 is patentably distinct over the prior art of record. It is respectfully urged that the rejection of claim 2 be withdrawn and that it be passed to allowance.

D. MISCELLANEOUS

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page(s) is captioned "**Version With Markings To Show Changes Made**."

In view of the foregoing and other considerations, the Examiner has ample bases for withdrawing all rejections and for allowance of all pending claims. Accordingly, a formal indication of allowance is earnestly solicited.

The Commissioner is authorized to charge the undersigned's deposit account #14-1140 in whatever amount is necessary for entry of these papers and the continued pendency of the captioned application.

Should the Examiner feel that an interview with the undersigned would facilitate allowance of this application, the Examiner is encouraged to contact the undersigned.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW
<u>CHANGES MADE</u>

The paragraph beginning at page 6, line 23 has been amended as follows:

As described above, the $Al_xGa_{1-x}As$ layer suffices as the current diffusion layer of a light-emitting diode, as far as the resistivity is concerned. In order for the $Al_xGa_{1-x}As$ current diffusion layer to be transparent with respect to light having a wavelength of 550 to 650 nm, it is required to prescribe an Al mole fraction x thereof to be 0.65 or more. However, when the Al mole fraction x becomes high, the $Al_xGa_{1-x}As$ layer will exhibit a deliquescence. Thus, in the case where a light-emitting diode having an $Al_xGa_{1-x}As$ layer with a high Al mole fraction x is operated under the conditions of high temperature and high humidity, [a] light intensity is likely to be remarkably decreased.

Please amend the paragraph beginning on Page 8, line 3, to read as follows:

Such a deterioration of a light-emitting diode will be described with reference to Figure 11. Figure 11 shows the light-emitting diode **200** previously described with reference to Figure **8**, but in a deteriorated condition. Since like components are designated with like reference numerals, the [explanation] <u>explanations</u> thereof are omitted here.

Please amend the paragraph beginning on Page 18, line 22, to read as follows:

Although the above descriptions are related to the case where the GaAs substrate is employed, the similar effects can be obtained with any other appropriate substrates, such as a GaP substrate, an InP substrate and the like. In the case where there is no limit to a material for the substrate, the lattice mismatch between the $(Al_xGa_{1-x})_yIn_{1-y}P$ current diffusion layer and the substrate may become about 8% at most with the variation of the

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In mole fraction. However, such a lattice [mismatching] <u>mismatch</u> will not have a significant effect on a resistivity of a bulk material.

Please amend the paragraph beginning on Page 19, line 11, to read as follows:

As described above, although the lattice mismatching is generated between the $(Al_xGa_{1-x})_yIn_{1-y}P$ current diffusion layer and the underlying light-emitting structure by decreasing the In mole fraction of the constituting material for the current diffusion layer, this will not have significant disadvantages on the characteristics of a resultant light-emitting diode. Thus, by decreasing the In mole fraction of the $(Al_xGa_{1-x})_yIn_{1-y}P$ current diffusion layer to increase an absolute value of a lattice mismatch in the negative phase, the resistivity of the $(Al_xGa_{1-x})_yIn_{1-y}P$ current diffusion layer can be reduced. Accordingly, by decreasing the In mole fraction 1-y as well as the Al mole fraction x of the $(Al_xGa_{1-x})_yIn_{1-y}P$ current diffusion layer so that the current diffusion layer becomes intentionally [lattice-mismatching] <u>lattice-mismatch</u> with the light-emitting structure, the resistivity of the $(Al_xGa_{1-x})_yIn_{1-y}P$ current diffusion layer can be prescribed at the same level as that of the conventional AlGaAs current diffusion layer. Thus, it becomes possible to form the satisfactory current diffusion layer even by using the $(Al_xGa_{1-x})_yIn_{1-y}P$ layer.

The paragraph beginning at page 35, line 13 has been amended as follows:

Light emitted from a portion of the light-emitting structure **11** right below the p-type electrode **8** cannot be taken out since it is blocked by the electrode **8**. Thus, by providing the current blocking layer **9** in the lower portion of the graded current diffusion layer **106** so as to be positioned right below the p-type electrode **8**, a current to be injected into the light-emitting structure **11** is allowed to be effectively spread so as <u>to</u> not flow in the portion right below the p-type electrode **8**. Thus, the light-emission from the portion right below the p-type electrode **8** is prevented. Accordingly, an invalid current

which otherwise flows into the portion right below the p-type electrode **8** is reduced, and a light-emission efficiency can be improved.

The paragraph beginning at page 38, line 5 has been amended as follows:

It is understood from Figure **7B** that since the Al and In mole fractions are high in an initial growth stage, the graded $(Al_xGa_{1-x})_yIn_{1-y}P$ current diffusion layer **106** shows a resistivity substantially the same as that of the light-emitting structure **11**. However, the Al and In mole fractions are decreased with the increase in the thickness, so that a resistivity is also decreased. It should be noted that in the light-emitting diode **150** provided with the current blocking layer **9**, a current is more likely to be spread throughout the whole chip through a portion of the current diffusion layer **106** which has a lower resistivity positioned closer to the p-type electrode **8**, whereby an operating voltage is less likely to be increased. On the other hand, even when a resistivity of the current diffusion layer **106** in a portion closer to the light-emitting structure **11** is relatively high there is no significant influence on [, a] current diffusion capability and [an] operating voltage [are hardly influenced].

VERSION WITH MARKINGS TO SHOW
<u>CHANGES MADE (IN THE CLAIMS)</u>

Claim 1 has been amended as follows:

1. {ONCE AMENDED} A light -emitting diode comprising:

a semiconductor substrate; and

a layered structure, made of an AlGaInP type compound semiconductor material and provided on the semiconductor substrate,

wherein the layered structure comprises:

a light-emitting structure composed of a pair of cladding layers and an active layer for emitting light provided between the pair of cladding layers; and

a current diffusion layer <u>comprising an AlGaInP type material</u> which is lattice-mismatched with the light-emitting structure, wherein a lattice mismatch $\Delta a/a$ of the current diffusion layer with respect to the light-emitting structure defined by the following expression is -1% or smaller:

$$\Delta a/a = (a_d - a_e)/a_e$$

where a_d is a lattice constant of the current diffusion layer, and a_e is a lattice constant of the light-emitting structure.